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**F**ifty percent of U.S. schoolchildren ages 5 to 17 years were caries-free in their permanent dentition in 1986-87. This is no myth, and it is not an erroneous claim. The estimate of 50-percent caries freedom in the permanent teeth of these children came from data collected by a national probability survey that used reliable epidemiological caries diagnostic criteria and was implemented by trained and calibrated examiners.

Edelstein and Douglass call attention to an introductory sentence in a brief communication authored by a public affairs specialist at the National Institute of Dental Research (NIDR) that was published in the *Journal of the American Dental Association* (1). The sentence states, "...half of the schoolchildren in the United States have never had a cavity."

General summary statements to introduce a subject are not uncommon in public communications directed at more general audiences.

Subsequent text usually adds specificity and depth to the initial summary. Seven sentences later, the communication includes the following statement: "The new survey revealed that 49.9 percent of all children have no decay in their permanent teeth (Italics added). The title of the communication provided the take-home message: Dental caries continues downward trend in children.

All scientific publications by staff members at NIDR made it clear that the 50-percent-caries-free finding pertains to the permanent dentition of children ages 5 to 17 years (2-7). However, communication of research findings to general audiences in a manner that imparts the most important results clearly and accurately is an issue that warrants careful discussion. Additional details may lend perspective to the issue.

The caries-free percentage for any age range becomes more informative when it is used as a summary

measure to compare caries trends over time. Only 26 percent of children 6 to 17 years-old were caries-free in their permanent teeth in 1971-74. The percentage increased to 35.2 in 1979-80, 48 in 1986-87, and to 53.7 in 1988-91. This represents a doubling of the percentage of children who had not experienced caries in their permanent teeth in less than two decades.

The cumulative extent of caries, as measured by the number of decayed, missing, and filled permanent tooth surfaces (DMFS), declined dramatically during the same period. In 1971, mean DMFS among children 6-17 was 7.3 surfaces. In 1979-80, it had decreased to 4.8 surfaces; in 1986-87, it was only 3.2 surfaces; and in 1988-91, the mean DMFS had decreased to 2.6 surfaces.

Age-specific reductions in caries were evident among children of all ages. The largest reduction was experienced among persons aged 17 years, for whom the mean DMFS declined from 16.9 to 8.0 surfaces between 1971-74 and 1986-87, slightly more than a 50-percent reduction in 15 years.

Caries in primary teeth has also decreased. Among children ages 5 to 9, decayed and filled primary surfaces (dfs) declined from 6.3 surfaces in 1971-74 to 5.3 surfaces in 1979-80 and 3.9 surfaces in 1986-87. However, a decline in primary caries was not apparent with the 1988-91 data.

Perhaps what has perplexed Edelstein and Douglass (and for that matter many in the dental community including staff members at the NIDR) can be described by the metaphor of the water glass being half empty or half full. The reduction observed in the level of dental caries in the United States in the past 25 years is an achievement for which the dental research community, public health programs and agencies, and the dental profession can take credit and pride. The extent of caries for the large majority of school children and adults younger than age 45 has diminished.

Despite these improvements in public health, caries remains one of the most common diseases to afflict Americans. The majority of teenage school children and most adults continue to suffer from caries and its sequelae. Subgroups within the United States continue to manifest especially high levels of the disease. Until caries is eradicated, the dental community must not become complacent in future efforts to control this preventable disease. Continued efforts to identify and refer people at high risk of developing caries before they actually experience the disease are essential.

## Most U.S. Schoolchildren Are Caries-Free in Their Permanent Teeth

This Is No Myth

NIDR supports research to reduce or eliminate caries. The Division of Extramural Research supports a broad agenda of research on caries etiology, prevention and treatment; the Division of Intramural Research conducts research to expand the science base with which to understand and prevent caries; and the Division of Epidemiology and Oral Disease Prevention currently is supporting research efforts targeting high-risk populations, evaluating the impact of specific cost-reimbursement plans on the placement of preventive dental sealants, and comparing caries prevention strategies for coronal and root caries in older adult populations.

Although all of us should be concerned with the extent of caries, we do not believe it is appropriate with data from cross-sectional epidemiological surveys to describe the extent of caries by combining caries in the primary and permanent dentitions, for reasons we will describe subsequently. The rest of the commentary details some of the technical concerns we have with the manner in which Edelstein and Douglass have approached the problem.

The principal way the level of dental caries is monitored is through population surveys. Composite profiles drawn from small clinical studies, such as those cited by Edelstein and Douglass, may sometimes provide a clue as to the correct profile of dental caries. These small studies are not probability samples of the United States population. They often are conducted on convenience samples or special populations. Frequently, different criteria are used to score caries, and little effort is spent training and evaluating clinical examiners. Furthermore, there are no widely accepted statistical methods for estimating the national extent of caries, based on sub-national studies.

Population based probability surveys, such as the National Health and Nutrition Examination Surveys (NHANES), the NIDR Adult Survey of 1985-1986 and the 1979-1980 and 1986-1987 NIDR Children's Surveys collectively provide the best information available regarding the dental caries status of the American population since the 1960s. These data bases can be used to monitor changes in the prevalence and severity of this disease for the entire population, and in some instances for specific subgroups as well. Some *caveats* are necessary when interpreting observed changes among these surveys, because of differences in sampling frames and possible changes in the overall population characteristics.

Primary and permanent teeth were scored for dental caries. The scoring criteria are more conservative than a clinical examination in a dental office but have proven reliable for large field studies and provide a consistent basis for evaluating trends over time. Dental radiographs have not been used in these population surveys because of risk-benefit concerns regarding unnecessary radiation exposure. Extensive training sessions were conducted by expert reference examiners in all of the NHANES and NIDR surveys. Field examiners were required to achieve high reliability levels before they could participate in these surveys.

In dental epidemiology, the summary statistic for dental caries in permanent teeth has been the DMFS. This index was originally designed to represent cumulative dental caries experience of children (8).

It functions as a lifetime cumulative caries index for the permanent dentition of persons with few missing teeth, for example, today's school children. It may be misleading as a cumulative caries measure in persons with numerous missing teeth (such as older adults) because it is not known if the missing teeth had caries.

The percentage of children who are caries-free is another commonly reported summary measure. It has referred usually to only permanent teeth and also is considered a cumulative caries history of the permanent dentition for a child. This common usage has led most in the dental community to understand that caries-free estimates refer to the permanent dentition, unless otherwise noted.

The mean dfs or DMFS score can be used legitimately to compare caries experiences for subgroups of the population. Standard statistical methods based on continuous distributions are appropriate for any of these summary measures. The central limit theorem ensures that the sample means will be normally distributed for large enough samples, regardless of the degree of skewness in these caries scores. Even sample sizes as small as 75 to 100 per group are usually sufficient to produce valid results for dental caries means, even from highly skewed distributions (9).

The age-specific caries-free scores have been shown to be highly correlated with DMFS scores (10). Whether one assesses caries by the group mean or by the percentage caries-free, one is capturing a considerable overlapping of information contained in the raw caries scores themselves. Knutson (11) and Korts and

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coworkers (12) have modeled this relationship directly.

NIDR has reported caries separately for primary and permanent tooth surfaces. Although the dfs score is a cumulative index of caries on primary teeth present, it does not provide a caries history for primary teeth that are missing due to natural exfoliation, which typically occurs between 6 and 12 years of age.

Let us be clear. We believe that caries in the primary dentition is an important disease. It should be prevented to the extent possible, and when it occurs, it should be treated, as appropriate. However, we do not believe that combining caries experience from the primary and permanent dentitions into one overall estimate is appropriate for several reasons.

There is no summary measure, based on cross-sectional data, that can reflect the cumulative caries history for school children on all primary and permanent teeth. For those younger than age 7, who typically have lost few primary teeth, reporting caries-free percentages for only the permanent teeth gives an incomplete life-time caries history for the combined dentitions. If primary and permanent caries-free estimates are reported separately, the complete caries history for school children remains incomplete because the caries status of missing primary teeth is unknown.

On the other hand, reporting the percentage of school children who are caries-free, based on primary and permanent teeth combined, is misleading because this rate also does not reflect a cumulative caries history. Particularly problematic is the reporting of combined caries-free estimates during the mixed dentition period, lasting approximately from 6 to 12 years of age. A combined measure calculated for this age range can produce pronounced bias in a cumulative caries-free estimate.

The problems caused by mixing caries experience on primary and permanent tooth surfaces are not restricted to the caries-free percentage summary measure. The mean number of surfaces affected by caries for the combined dentitions also could be misleading. The mean number of surfaces with dental caries calculated by combining dfs and DMFS scores is not a cumulative caries index and furthermore can result in decreased mean scores in older children, especially during the period of mixed dentition.

Most importantly, estimates of caries, based on the combined primary and permanent dentitions, give equal weight to caries in each dentition and obscures important functional differences between the two dentitions. Consider the different consequences to a caries attack on the first primary molar and the first permanent molar of a 10 year-old child. The primary molar will naturally exfoliate in a short time, possibly in a few months and almost certainly in less than 2 years. It may be mobile and non-vital due to impending exfoliation, in which

case, treatment of the caries may not be appropriate. Alternatively, the permanent molar of a 10 year-old must last for rest of the child's life and is one of the keys to maintaining good occlusion.

The future for the oral health of Americans looks bright. The great achievements of the caries prevention efforts of the 1970s and 1980s are being observed in shifts in the caries levels among adults. Recent analyses demonstrate for the first time that between the early 1970s and the mid 1980s reductions in caries also occurred among employed American adults younger than 45 (13). The nation must continue its commitment to caries research and prevention, so that future generations of Americans will suffer less from caries than past generations.

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